TACTUAL ORIENTATION/MOBILITY MAPS PRODUCTION & TESTING

Susan Von Gruenigen
The Ohio State University (1977-1979)
Battelle Laboratories
Columbus, Ohio 43201

I. Introduction: The Problem

Tactual maps are maps read, at least in part, with the sense of touch. Providing tactual maps which are efficient in terms of production and effective in terms of communication is becoming a major concern on university campuses. An investigation into production at The Ohio State University has resulted in the manufacture of tactual orientation maps for the visually impaired. Consideration of tactual mapping processes led to actual production and testing of three methods. The final maps were produced with the method that best fit the particular requirements of this university.

Most campuses that have a population of visually handicapped need to provide the means for acquisition of independent mobility. The visually impaired have commonly relied on verbal instructions with or without actual physical guidance. For further travel, route information has been remembered and fit into previous concepts to form a kind of mental map. The accuracy and completeness of this cognitive map has, to a large extent, determined whether or not an individual would have the opportunity to be an independent traveler.

Maps with raised symbols have generally not been available. Construction of tactual maps has not been an easy process. There is a lack of knowledge about tactual perception. Unlike the maker of a visual map the tactual map maker does not have a wealth of mapping experience on which to base decisions. The first very serious problem is that effective tactual mapping depends on careful research and on many contacts with the map users themselves.

There is another difficulty with the communication of concepts through the use of tactual symbols. Tactual symbols are unfamiliar to the map user since there is rarely an automatic association of meaning with the symbol. This results in difficulty with map reading. It seems hopeful that as maps become more common and standard symbols are used that meaning will be more readily associated with most symbols.

Another problem which does not seem to have a solution is the greatly reduced information content on a tactual map. The map features must be generalized and simplified due to the relatively poor discrimination level of the tactual sense. Map scale must be increased and, in fact, a visual map which fits on one page may take six pages when converted to a tactual map and still not convey as much information.

The user population is very small, less than 1% of the population. This combined with a lack of experience with tactual maps, has resulted in little awareness on the part of the community of a need for tactual graphics. Funds have been difficult to obtain and an ongoing interest in production has not been available. Currently these conditions seem to be changing and many universities are obtaining maps. Maps were made by M.I.T. in the early 1970's and more recently Harvard, Boston College and The Ohio State University have provided tactual maps.

II. Production: A Look at Alternatives

Production of multiple copy maps usually requires a master or mold. There are basically three methods of manufacture which are used alone or in combination. They are: deposition, embossing and engraving. When various materials are attached or glued to the surface of a plate it is called deposition. Sandpaper, screen, poster board, string, and wire are common materials used in this process. The University of Nottingham has produced a kit which contains preformed symbols.(7) The resulting maps have consistently formed features and take no special skill or training for construction.

Embossed maps are made by raising the surface of the plate itself. This is usually done by pressing symbols into the back of aluminum foil or plastic sheets. It is common to use this method in combination with deposition since deposition is most effective for areal symbols while embossing produces linear and point symbols most effectively. Gilligan Tactiles Inc. (6) has produced an embossing kit which includes all needed materials including a template and embossing tools. Use of the kit gives greater control of symbol height and design. Another advantage of this kit is that it provides the means for a non braille writer to add braille to the map surface.

Engraved masters are made by cutting into the surface of the plate to produce a raised image. A master can be made commercially from a drawing by photo-chemically engraving the image in a polymer plate. (9) The process eliminates hand construction of the master and requires fewer man hours if competent drafting is available. The plates are costly and only one raised height is possible.

Engraved masters can also be made using numerically controlled machine tools (NCMT) and do produce a master with variable height surface. John Gill and J.P. Andrew, in England, first developed this process. (5) A summary of the capabilities of the system as described by Gill is as follows:

1) Digital input from a base map.
2) Editing on line which includes addition and deletion of lines and point symbols.
3) Changes of scale.
4) Changes of elevation and type of line.
5) Conversion of typed text to grade 1 braille.
6) Creation of paper tape dump or data file.
7) Output on digital plotter.
8) Output on control tape for NCMT.

Gill's method is currently being implemented at Baruch College, Computer Center for the Visually Impaired with the assistance of Leslie Clarke and the American Foundation for the Blind. (2)

There are numerous other methods which have been tried or are currently being investigated. In the past

Virkotype or thermograving, used to make raised lettering on business cards, was tried along with silk screening.(8) Surface quality of the raised portions of these maps was difficult to control. More recently Harry Friedman of Howe press, Perkins School for the Blind has been working on perfecting the manufacture of maps out of polyvinyl chloride. This material, originally used for lace place mats, is very flexible and has a tactually pleasing surface. (4)

III. Evaluation: Efficiency, Quality, and Readability

Consideration must be given to the type of production that will best fit the needs of a particular situation. Basic prerequisites must first be identified and the local situation must be evaluated. Questions to be answered first are: 1) Will the mapping program have ongoing support in terms of funds and personnel? 2) Are there persons willing to devote the time necessary to research the possibilities and limitations? 3) Does interest come from special interest groups, students, faculty, or administration? Answers to these questions will determine whether volunteers are used to construct maps, whether maps are produced by an outside firm or organization, or whether permanent local facilities are set up for production.

The Ohio State University was considering incorporation of tactual map production into the mapping program of the Administrative Office of Campus Planning. In this office there exists very firm support with the limitation that the personnel have, at least in the initial stages, never made tactual maps and have had little contact with design problems. The production method needed to take these factors into account. Three methods were chosen for further investigation: deposition using the Nottingham Kit, embossing using Gilligan's Kit and engraving using Nyloprint polymer plates. (3) Outside production by Gilligan (6) was also a possibility if it proved to be more efficient than production within the office.

Evaluation of the maps was approached from three points of view: the efficiency of the method of manufacture which includes the availability of resources, the physical qualities of the maps themselves based on known design requirements, and the readability of the maps.

The efficiency of the method was dependent on cost of materials, permanent equipment and labor, on time for construction and ordering materials, on the amount and type of skill required for construction, and on the compatability of the method with personnel and equipment already available. It is an hypothesis that the less disruptive the mapping program is, the greater the likelihood that it will continue effectively. A summary of the results of this comparison is shown in Table 1.

	Deposition Nottingham	Embossing Gilligan	Engraving Nyloprint
Cost per master	$1.50	$1.00	$35.00
Time for Construction	60 min.	120 min.	60 min.
Time Obtain Materials	6 weeks	4 weeks	1 week
Skill	average	above average	expert drafting

Table 1 - Comparisons of Cost, Time, and Skill*

The effects manufacturing has on the quality of the final map should be another consideration. A map of high quality will be effective. Some of the more important attributes of an effective map are:

1) Minimum height of .02" and symbol separation of .125".
2) Portable, lightweight, flexible, crease resistant and unaffected by temperature extremes.
3) Durable, strong, resistant to wear and water repellant.
4) Visual surface for those with partial vision.
5) Consistency between maps and symbols.
6) Precision of symbol height, size, shape and location.
7) Flexibility, the availability of a variety of symbols, scales and heights.
8) Readability or a surface which communicates effectively.

*These are approximate values based on this experimenter's experiences. The values will change with time and personnel and are included for comparison only.

The maps made by the three methods were compared on the basis of consistency/precision and flexibility. All of the maps were made of Braillon (1) so they had the same qualities of portability, durability and visual surface. The readability of the maps was examined separately.

In order to compare maps objectively ratings were designed which attempted to facilitate comparisons of multiple attributes. Objectivity is not completely possible because the relative merits of various attributes is not understood. The ratings have been arbitrarily chosen as follows:

4 pts	No improvement in quality can be anticipated.
3 pts	Limited and insignificant improvement is possible.
2 pts	Very acceptable quality with some important improvement possible.
1 pt	Acceptable but with no outstanding attributes.
0 pts	Unacceptable or the attribute is absent.

An average rating for the quality of each map can then be calculated. Map quality has been summarized in Table2.

The readability of the maps was most difficult to evaluate. The concern was with production, design and changes that may occur in effective communication. There are three methods of investigation which seem to be in use; informal opinion surveys, formal surveys in which opinions are obtained using controlled questions, and tests which require problem solving and may or may not be timed. The last method is less subjective and comparisons can be made between maps with more reliability. There is a possible danger that with highly controlled testing less insight into the real problem may be obtained. Informal questions and discussions are also valuable.

Maps can be tested with either visually handicapped or blindfolded sighted subjects. There does appear to be evidence that use of sighted blindfolded subjects gives comparable results. For this test, however, the visually handicapped were used. These persons, especially those who have no memory of sight, may have unique conceptions of space. It may prove to be worthwhile to test readability using the visually handicapped even though the

	Consistency & Precision		Flexibility		
	Horizontal	Vertical	Symbol Type	Symbol Height	Scale
Nottingham Average 2.0	2 Braille label edges interfere with reading.*	3	1 Dot spacing of lines not variable. No other symbols possible.	2 Variation of line and point heights not possible.	2 No variation in symbol size is possible.
Gilligan Kit originally designed for single map production. Average 1.6	3	1 Bumps in line and poor corner height. All symbols too low.*	1 Same as Nottingham.	1 The flexibility that does exist is difficult to control.	2 Same as Nottingham.
Photo Engraving Average 2.6	3	4	3	0 There is no way to vary symbol height without adding to final surface.	3

<u>Multiple Copy Map Quality</u>

Table 2

*Note: Many of the above difficulties could be corrected with more skilled construction.

population is small and diverse in terms of type and extent of handicap. If readability is to be tested in a map context, questions should reflect the kind of problems that will be solved in actual map use. The subject may be asked to identify, locate symbols or to choose a route. The map made with the Nottingham kit was found to be most readable in terms of response time.

IV. Conclusions

In summary, the efficiency of the method of production, the quality and readability of the maps must be evaluated if tactual maps are to become a real orientation and mobility aid to the visually handicapped community.

Photoengraved Nyloprint plates were chosen for final production at The Ohio State University. It was felt that the experienced drafting personnel would be able to produce a high quality master. The design decisions which must be made will be based initially on thorough research. It is hoped that as the maps are used, input into design needs will come from the visually handicapped themselves and from further research into design. The cost, while high, was less than the cost of producing maps by commercial production.

1. American Thermoform Corp. 8640 E. Slauson Ave. Pico Rivera, Calif. 90660 Telephone (213) 723-9021
2. Baker, Randy, Computer Center for the Visually Impaired, Baruch College, 46 E.26 St., N.Y., N.Y.10010
3. BASF Wyandotte Corp. Wyandotte, Michigan 48192
4. Friedman, Henry, Director, Howe Press, Perkins Inst. for the Blind, Watertown, MA. 02172
5. Gill, John M. "Design, Production and Evaluation of Tactual Maps for the Blind", Unpublished Doctoral Thesis, Dept. of Engin., University of Warwick, 1973
6. Gilligan, Joseph, Pres. Gilligan Tactiles Inc. Carol Center, 770 Center St., Newton, MA.
7. James, G.A. & Armstrong, J.D., Handbook of Mobility Maps, Dept. of Psychology, University of Nottingham.
8. Kidwell, A.M., Greer, P.S., Sites Perception and the Nonvisual Experience, N.Y.: American Foundation for the Blind, 1973.
9. Sherman, J.C., "The Challenge of Maps for the Visually Handicapped." Paper presented at 9th I.C.A.
10. Weidel, J.W., Groves, P.A., Tactual Mapping, Occasional Papers in Geog., University of Maryland, 1972